A New Indicator of Ecosystem Restoration Benefit: The Biodiversity Security Index

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Presentation Objectives:

- Summarize restoration planning issues
- Determine desired benefits metric attributes
- Summarize BSI and habitat unit metrics
- Compare metric attributes

Basic Issues

- The Corps is authorized to improve EQ
- EQ improvement is limited to ecosystem outputs
- Congress requires benefits to at least equal costs
- Corps policy requires nonmonetary benefit metrics
- Programs need to rank projects based on benefit
- No single metric has been found widely suitable
- Different metrics have proliferated
- Communication problems have resulted

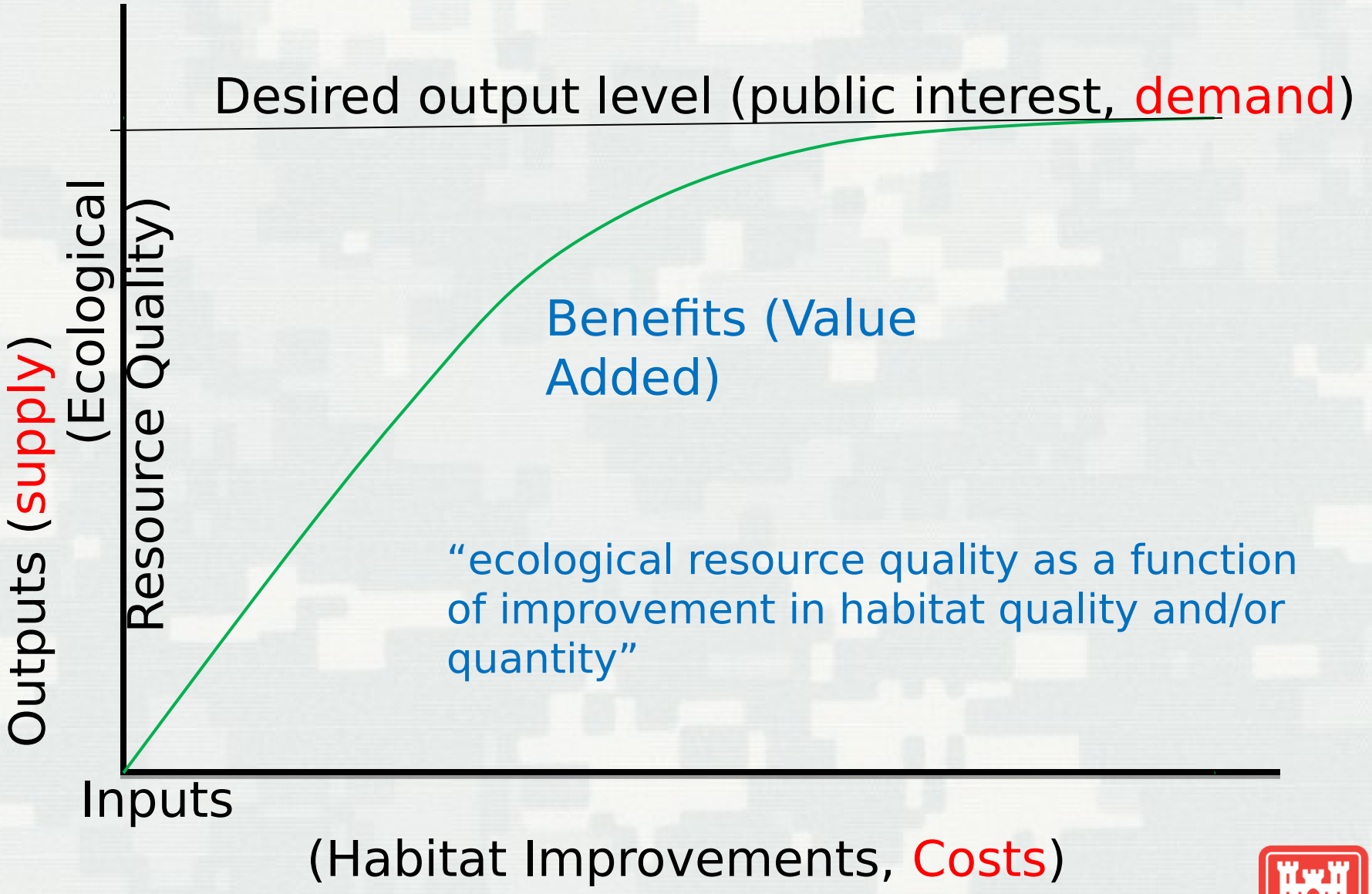
Policy Sources of Desired Attributes:

Authority (Section 206, 1996 WRDA)

- The Secretary may carry out an aquatic ecosystem restoration and protection project if the Secretary determines that the project– (1) will improve the quality of the environment and is in the public interest; and (2) is cost-effective.

Federal Project Planning Objective (PGN, USACE 2000)

- Protection of the Nation's environment is achieved when damage to the environment is eliminated or avoided and important cultural and natural aspects of our nation's heritage are preserved.
- Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units).

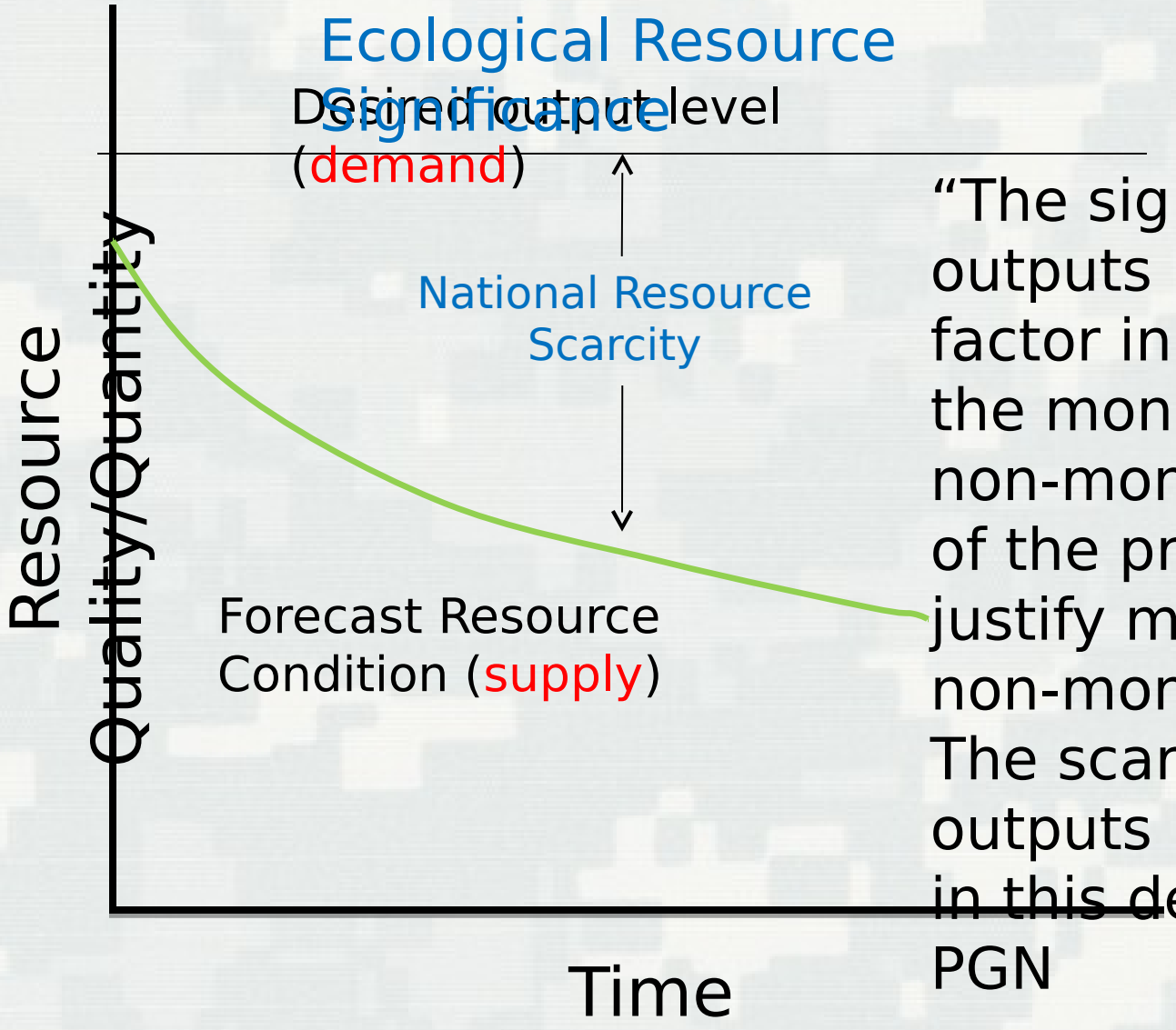

Desired output level (public interest, demand)
Outputs (supply)
(Ecological
Resource Quality)
Benefits (Value
Added)
“ecological resource quality as a function of improvement in habitat quality and/or quantity”
Inputs
(Habitat Improvements, Costs)

PGN Examples of Habitat Improvement (Inputs):

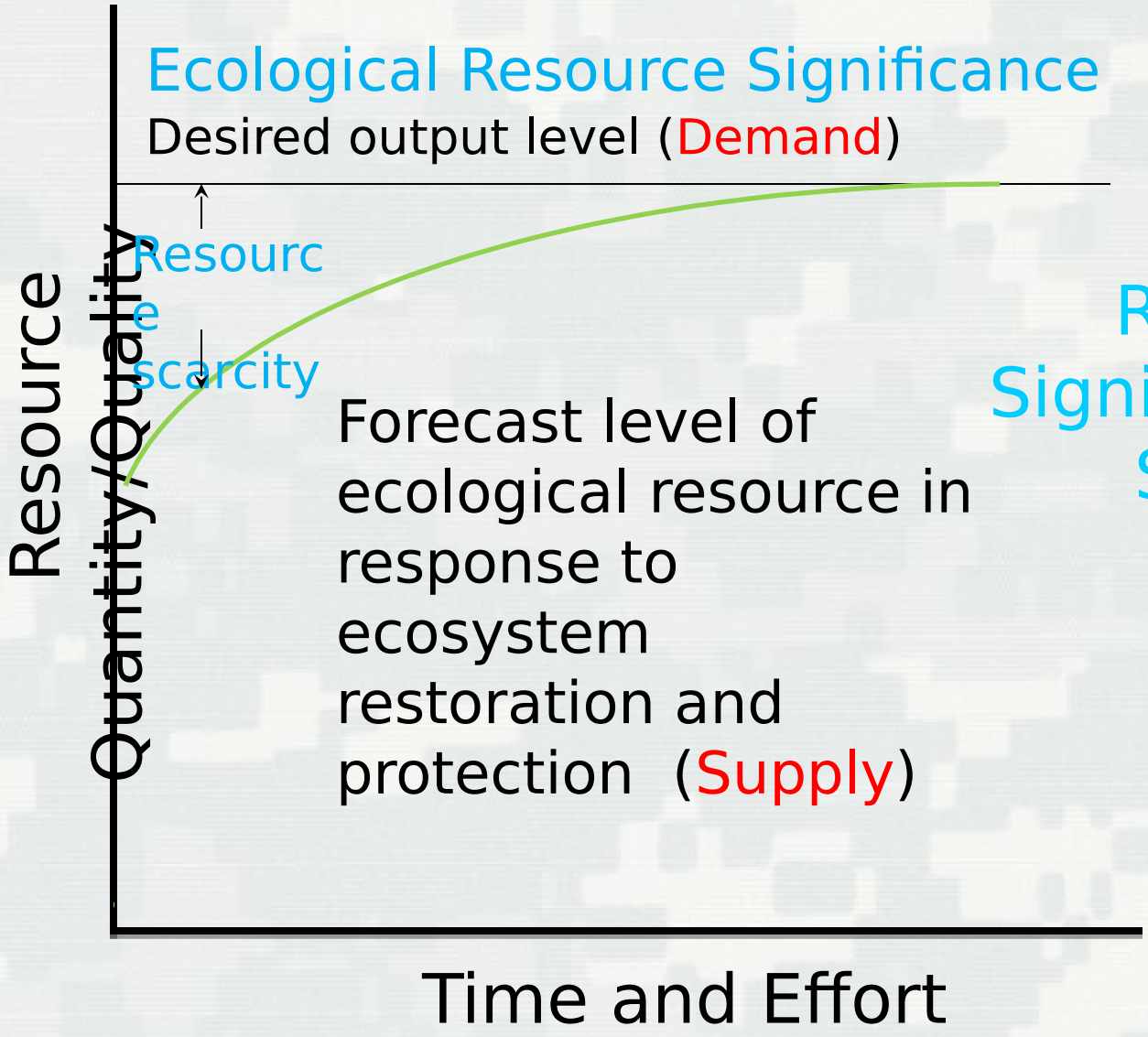
- Use of dredged material to restore wetlands
- Reconnection of oxbows to the main channel
- Providing for more natural channel conditions
- Modifying blocked fish passage; e.g., dam removal
- Modifying dams to improve oxygen or temperature
- Removing structural impediments to hydrology
- Restoration of native aquatic and riparian vegetation

PGN Examples of Ecological Resource Quality Metrics (Outputs):

- Habitat-based
  - Increased habitat units
  - Increased acres of spawning habitat
  - Increased stream miles of habitat
  - Increased diversity indices
- Population-based
  - Increased number of breeding birds
  - Increased abundance of target species
  - Increased diversity indices



"The significance of the outputs is a critical factor in determining if the monetary and/or non-monetary benefits of the proposed project justify monetary and/or non-monetary costs. The scarcity of the outputs is also a factor in this determination." PGN


Ecological Resource Significance
Desired output level (Demand)
Resource scarcity
Resource Quantity/Quality
Forecast level of ecological resource in response to ecosystem restoration and protection (Supply)
Time and Effort

Resource Significance and Scarcity

Study Objective

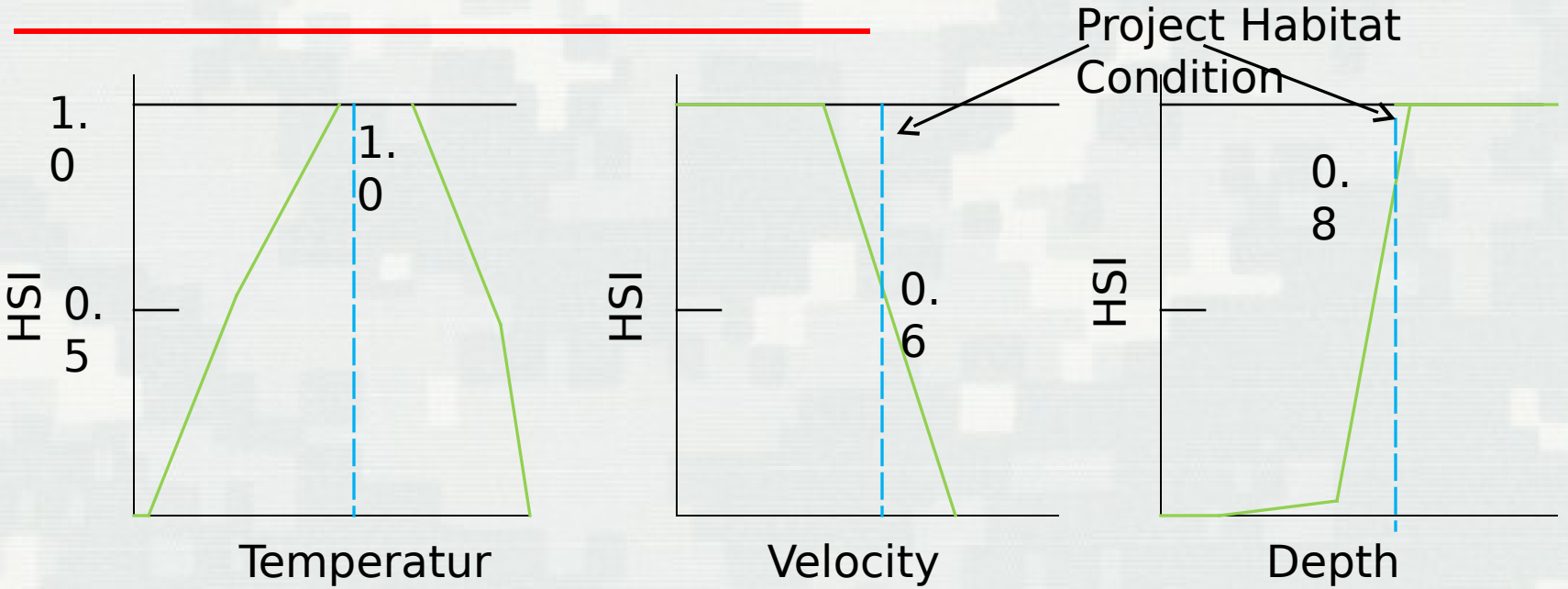
- A less degraded, more natural ecological resource condition
- Ecological indicators of success
  - ► High native plant and animal diversity (direct value)
  - ► More biologically desirable species (direct value)
  - ► Self-regulating ecosystem support (indirect value)
  - ► More of indicator species (indirect value)

Note: No explicit mention of habitat

Desired Metric Attributes:

- Indicates ecological resource quality
- Reflects public interest in natural heritage
- Indicates resource scarcity
- Indicates sustained value added
- Is commensurate across projects

Habitat Units



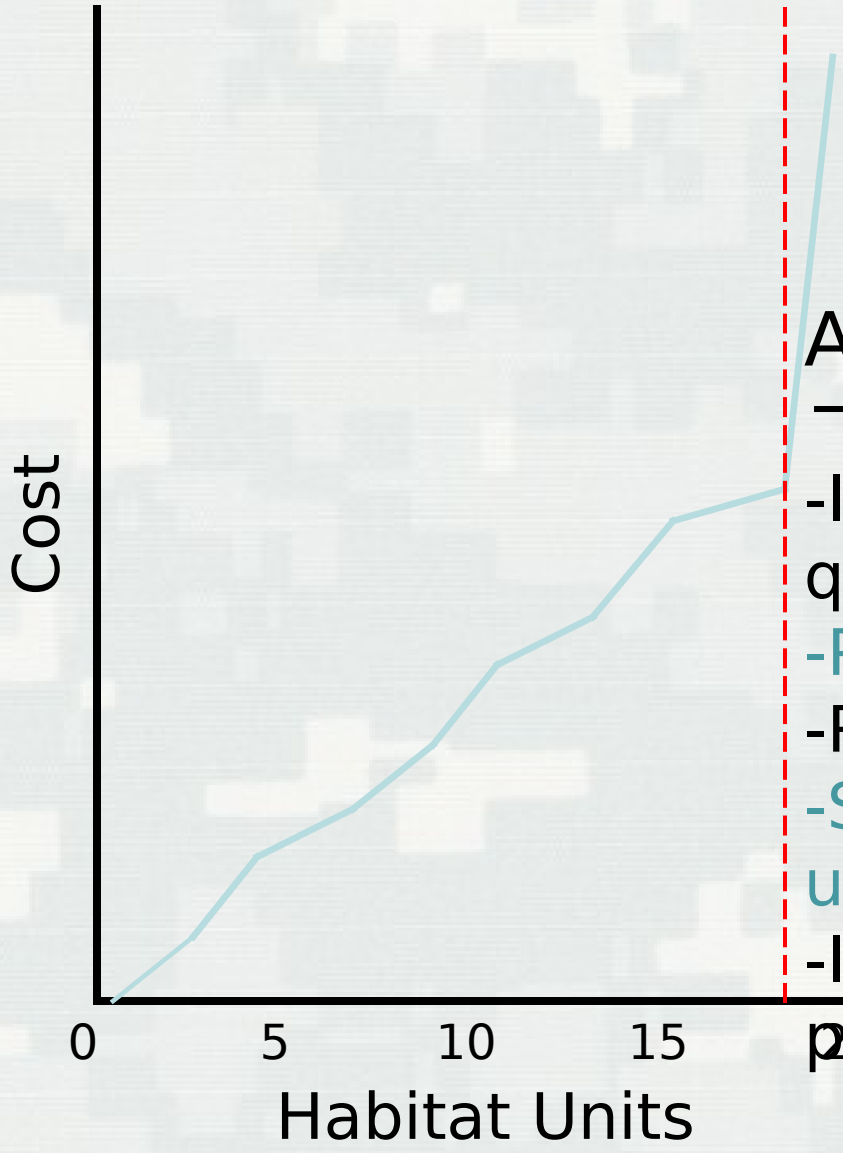
Simple Example of HU Calculation

Composite HSI score = 1.0x0.6x0.8=0.48

Acres = 12

Habitat Units = Acres x Composite HSI

HU = 12 x 0.48 = 5.76



Attributes

-Indirect index to resource quality

-Public interest is unclear

-Resource scarcity is unclear

-Sustainable value added is unclear

-Is not commensurate over projects

Biodiversity Security Index:

$$BSI = \sum_{s=1}^{S} (h(wR)(wD)(wG)(A_1 - A_0))_s$$

S = species, (n = total number)

A_1 = final number of viable population units

A_0 = initial number of viable population units

wG = policy weighted security status

wD = policy weighted distinctiveness (0 to 1)

wR = risk (probability of success; 0 to

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Viable Population Units (A):

- **Viable population concept**
  - May target whole population for many species
  - 5,000 to 10,000 members for larger species
  - # varies with species—related to individual size
- **Subpopulation concept**
  - May target subpopulations for some species
    - Large mobile species with few populations
    - Reproductive pairs & larger groups

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Security Status (G):

Security Status		Viable Pop. Units	Weight
GX	Presumed Extinct	0	0
GH	Possibly Extinct (Watch)	?	0
G1	Greatly Imperiled	>0 < 6	64
G2	Imperiled	6 < 24	16
G3	Vulnerable	24 < 96	4
G4	Generally Secure (Watch)	96 < 384	1
G5	Secure	>383	0

Information is provided by NatureServe Explorer

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Distinctiveness (D):

- Based on taxonomic distinction
- D = 1/ x where x is # of species in Family
- A Family with:
  - 1 species = 1.000
  - 5 species = 0.200
  - 30 species = 0.033
- The term reduces index based on security
- Ultimately, genetic methods are best

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Probability of Success (R):

- Project Area Limiting Factors 0.1
- Connectivity 0.5
- Resource Population Reliability 0.9
- Materials/Energy Reliability 0.5
- Invasive Species 0.9
- Disturbance scale 0.5

Mean Probability (R value) 0.6

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TABLE 1. Example of basic calculations to determine the BSI score.

Species/ Pops		G	G Wt	D	D Wt	R	R Wt	H	Score
SPS 1	1	GH	0	-	-	-	-		0.00
SPS 2	1	G1	64	0.11	1.0	0.9	1.0	1	6.34
SPS 3	1	G2	16	0.05	1.0	0.6	1.0	1	0.48
SPS 4	2	G2	16	0.50	1.0	0.1	1.0	1	1.60
SPS 5	1	G3	4	0.08	1.0	0.7	1.0	1	0.22
SPS 6	1	G3	4	0.20	1.0	0.3	1.0	0	0.00
SPS 7		G4	1	0.3	1.0	0.4	1.0	1	0.01

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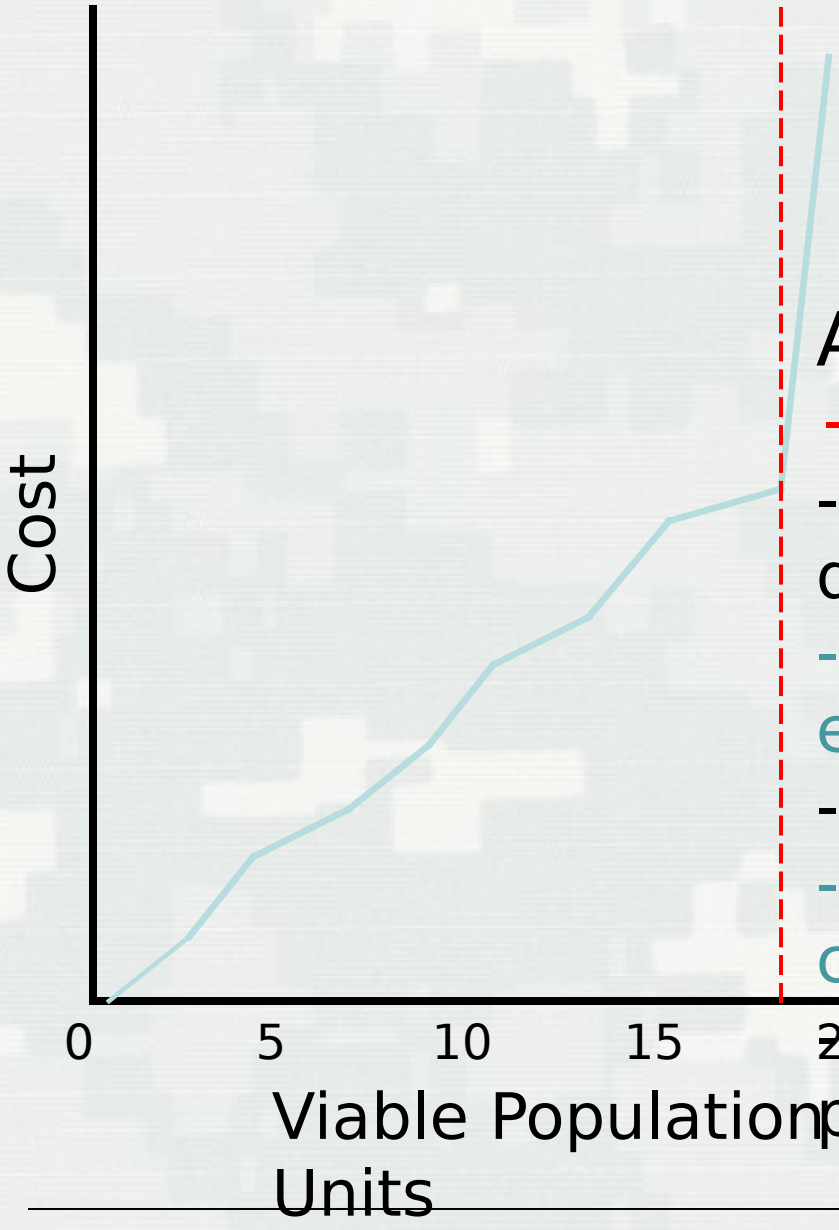

Attributes

-Directly indicates resource quality

-Public interest is clearer –ESA etc

-Resource scarcity is clearer

-Sustainable value added is clearer

-Is commensurate across projects

Metric Comparison Summary

HU

- Indirect indicator of ecological resource quality
- Public interest is unclear
- Resource scarcity is unclear
- Uncertain sustainability value
- Not commensurate

VPU

- Direct indicator of ecological resource quality
- Public interest indicated in ESA
- Indicates resource scarcity
- Indicates sustainability value
- Commensurate across projects

Stages of BSI Development:

- Review of nonmonetary measures
  2008
- Basic Concept Development
- Concept formulation
- Concept Description & Documentation 2009
- Concept Comparison to Existing Metrics
- Concept Refinement 2010
- Technical and policy vetting (review process)
- Case study application for Feasibility Study
- Risk assessment protocol 2011
- Integration with planning process/protocols
- User guidance
- Concept Implementation
- PCX resources
- Training

Conclusions

- Conceptually, indication of benefit is better served by VPUs than by HUs.
- Much less has been invested in developing VPU concepts than HU concepts
- Practical guidance and application issues need to be better addressed for both approaches
  - Forecasting ecological resource quality condition
  - Resource significance and scarcity
  - Sustainability
  - Commensurate indication of benefit